

REMARKS

I. Introduction

In response to the final Office Action dated July 22, 2009, Applicants have amended claims 9 and 13-15. Support for the amendments to claim 13 may be found in original claim 15. Support for the amendments to claims 9, 14 and 15 may be found, for example, in paragraphs [0022]-[0024] of the specification. Applicants have been careful to avoid the introduction of new matter.

A Request for Continued Examination (RCE) is being filed concurrently with this Amendment.

For the reasons set forth below, Applicants respectfully submit that all pending claims are patentable over the cited prior art references.

II. The Rejection of Claims 14-18 Under 35 U.S.C. § 102

Claims 14-18 stand rejected under 35 U.S.C. § 102(b) as being anticipated by JP 2001/015012 ("JP '012"). Applicants respectfully submit that JP '012 does not anticipate the pending claims for at least the following reasons.

With regard to the present disclosure, independent claim 14 recites a carbonaceous material projection structure comprising a plurality of carbonaceous material projections provided according to a predetermined arrangement, a density of the carbonaceous material projections being not less than 4 projections/ μm^2 , the plurality of carbonaceous material projections being formed by etching using a mask, and tips of the projections being smaller than roots of the projections.

In addition, independent claim 15 recites a carbonaceous material projection structure comprising a plurality of carbonaceous material projections provided according to a predetermined arrangement, each carbonaceous material projection having an approximately conical shape, the approximately conical shape being formed by etching a mask, and an apex angle of each carbonaceous material projection being not more than 39 degrees.

One feature of the present disclosure is that the carbonaceous material projection structure comprises a plurality of carbonaceous material projections that are formed by etching using a mask. For example, as shown in Fig. 1 of the present disclosure, a metal mask 13 is used to form the conical carbonaceous material projections 14. As a result of this feature, the structure can control the uniformity of the projection height, the interval between the projections, and the apex angle of the projections, and the carbonaceous material projection structure can emit a large amount of electron current because a density of the carbonaceous material projections is not less than 4 projections/ μm^2 .

It is alleged in the Office Action that JP 2001-015012 teaches the carbonaceous material projection structure according to claims 14 and 15 of the present disclosure. However, JP '012 teaches that the projections are formed without the use of a mask. Rather, JP '012 only teaches that the gate is formed through a mask. For example, as is taught in paragraph [0007] of JP '012, a carbon film is grown over the entire surface of the gate and then removed by using hydrogen plasma treatment. Thus, JP '012 fails to teach or disclose the limitation of claim 14 that a plurality of carbonaceous material projections are formed by etching using a mask, or the limitation of claim 15 that the carbonaceous material projection has an approximately conical shape being formed by etching a mask.

Anticipation under 35 U.S.C. § 102 requires that each and every element of the claim be disclosed, either expressly or inherently in a prior art reference, *Akzo N.V. v. U.S. Int'l Trade Commission*, 808 F.2d 1471 (Fed. Cir. 1986). At a minimum, for the reasons set forth above, JP 2001-015012 does not disclose all of the limitations of amended claims 14 and 15. Therefore, as it is apparent from the foregoing that 2001-015012 fails to anticipate amended claims 14 and 15 or any dependent claims thereon, Applicants submit that amended claims 14 and 15 are allowable and patentable over the prior art. As such, Applicants respectfully request that the § 102 rejection of claims 14 and 15 be withdrawn.

III. The Rejection of Claims 9-18 Under 35 U.S.C. § 103

Claims 9-18 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over JP 2001/015012 ("JP '012") in view of Baik (Thin Solid Films 377-378 (2000) 29-302) and further in view of Cathey (USP No. 6,423,239) and Ageno (USP No. 5,449,435). Applicants respectfully submit that JP '012, Baik, Cathey and Ageno fail to render the pending claims obvious for at least the following reasons.

With regard to the present disclosure, amended independent claim 9 teaches a method of forming one or more carbonaceous material projections, the method comprising the steps of applying a resist onto a carbonaceous material substrate; forming holes in the applied resist, the holes being provided according to a predetermined arrangement, each hole having a wall surface, and the wall surface being inversely tapered from an aperture thereof toward a bottom thereof; depositing mask material for a mask on the carbonaceous material substrate to form a mask deposition in each hole; lifting off the mask material deposited on the resist together with the resist to form a mask, the mask having a shape of a circular cone and a circular truncated cone;

and etching the carbonaceous material substrate by using the mask to form one or more carbonaceous material projections.

In addition, independent claim 13 recites a method of forming a carbonaceous material projection, the method comprising the steps of: forming a film on a carbonaceous material substrate, the film being made of one of a silicon-based nitride (SiN_x : $0 < x < 1.33$) and silicon-based nitride oxide (SiO_xN_y : $0 < x < 2$, $0 < y < 1.3$); applying a resist onto the film formed on the carbonaceous material substrate, patterning the resist by one of photolithography and electron beam exposure to form a patterned resist of a dot shape, and processing the film by use of the patterned resist as a mask; and etching the carbonaceous material substrate by use of an etching mask including the processed film to form a carbonaceous material projection, an apex angle of the carbonaceous material projection being equal to or less than 39 degrees.

As was mentioned above, JP '012 fails to teach or suggest that the carbonaceous material projections are formed with a mask. Because of this, it follows that JP '012 fails to teach or suggest the steps of lifting off the mask material deposited on the resist together with the resist to form a mask, the mask having a shape of a circular cone and a circular truncated cone; and etching the carbonaceous material substrate by using the mask to form one or more carbonaceous material projections.

Furthermore, with regard to claim 9, JP '012 does not and is not relied upon to teach that the apex angle of the carbonaceous material projection is equal to or less than 39 degrees. Moreover, Baik fails to remedy this deficiency. Rather, Baik discloses that an apex angle of the projection for an emitter is equal to or greater than 45 degrees and that the projection is formed

by an SiO₂ mask. However, Baik fails to teach or suggest the limitation of claim 9 of using a mask with a circular cone or circular truncated cone shape to form carbonaceous projections.

It is alleged that Cathey teaches using a mask and resist system. However, as shown in Fig. 2-7 and discussed in col. 6, lines 28-32, the resist 32 is applied over the mask 30. As such, the resist is not “applied to the carbonaceous material substrate” as required in claim 9.

Furthermore, Ageno does not remedy this deficiency. In Ageno, a first oxidized layer is formed, etched, and then a second oxidized layer is formed. Nowhere is there any mention of a mask formed on a carbonaceous substrate. Moreover, Ageno fails to disclose a hole formed in the first or second layer having a wall surface, and the wall surface being inversely tapered from an aperture thereof toward a bottom thereof. As such, it is clear that the combination of JP 2001-015012, Baik, Cathey and Ageno fails to teach or suggest all of the limitations of claim 9 or claim 13 of the present disclosure.

Moreover, as claims 14 and 15 have been shown above to not be anticipated by JP 2001-015012, and Baik, Cathey and Ageno do not and are not relied upon to remedy these deficiencies, it is clear that claims 14 and 15 are not rendered obvious by the cited prior art.

In order to establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. As is clearly shown, JP 2001-015012, Baik, Cathey and Ageno do not disclose the limitations of amended claims 9 and 13-15. Accordingly, Applicants submit that JP 2001-015012, Baik, Cathey and Ageno do not render amended claims 9 and 13-15 of the present disclosure obvious and as such, amended claims 9 and 13-15 are patentable and allowable over the cited prior art. Accordingly, Applicants respectfully request that the § 103(a) rejection of amended claims 9 and 13-15 be withdrawn.

IV. All Dependent Claims Are Allowable Because The Independent Claim From Which They Depend Is Allowable

Under Federal Circuit guidelines, a dependent claim is nonobvious if the independent claim upon which it depends is allowable because all the limitations of the independent claim are contained in the dependent claims, *Hartness International Inc. v. Simplimatic Engineering Co.*, 819 F.2d at 1100, 1108 (Fed. Cir. 1987). Accordingly, as claims 9 and 13-15 are patentable for the reasons set forth above, it is respectfully submitted that all pending dependent claims are also in condition for allowance.

V. Conclusion

Having fully responded to all matters raised in the Office Action, Applicants submit that all claims are in condition for allowance, an indication of which is respectfully solicited.

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417 and please credit any excess fees to such deposit account.

Respectfully submitted,

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